CLAIMS

We claim:

1. A three-dimensional display comprising:

a two-dimensional display, which comprises a plurality of color subpixels arranged in rows extending in a horizontal direction and in columns extending in a vertical direction which is substantially perpendicular to the horizontal direction, the color subpixels of red, green and blue being arranged periodically in the rows, and the color subpixels of the same color being arranged in the columns; and

a lenticular sheet provided on the two-dimensional display and having a plurality of cylindrical lenses through which the color subpixels are viewed and which are arranged in parallel with one another, the central axis of each cylindrical lens being inclined at an angle of θ to the column of the two-dimensional display,

wherein, when a pitch of the color subpixels in the horizontal direction is p_x, a pitch of the color subpixels in the vertical direction is p_y, and a color subpixel group constituting one three-dimensional pixel includes $3M \times N$ number of color subpixels where 3M is the number of color subpixels in each row corresponding to one of the cylindrical lenses and N is the number of color subpixels in each column corresponding to one of the cylindrical lenses, a relationship, $\theta = \tan^{-1} (3p_x/NP_y)$, is satisfied.

2. The three-dimensional display according to Claim 1, wherein the two-dimensional display that has color subpixels is selected from the group consisting of a liquid crystal display, an organic EL display, and a plasma display.

3. The three-dimensional display according to Claim 1 or 2, wherein the N is the multiples of 3.

4. The three-dimensional display according to any one of Claims 1 to 3, wherein, in a construction of the three-dimensional pixel, $Np_y \leq 3Mp_x$ is satisfied.

5. The three-dimensional display according to any one of Claims 1 to 4, wherein when a horizontal width and a vertical width of the color subpixels are w and h respectively, $w = 3p_x/N$ is satisfied.

6. The three-dimensional display according to any one of Claims 1 to 5, wherein a value of the w is within a range of from $[1-(1/2)(h/p_y)](3p_x/N)$ to $[1+(h/p_y)](3p_x/N)$.

7. The three-dimensional display according to any one of Claims 1 to 6, wherein a value of the h is the same as or approximate to a value of the p_y.

8. The three-dimensional display according to any of Claims 1 to 4, wherein when a distribution of a maximum intensity distribution of rays emitted from one color subpixel is represented by a function f(s, t), and a straight line, which is in parallel with the central axis of each cylindrical lens and in which a horizontal distance between the straight line and the central axis is x, is represented by $s = -t \tan\theta + x$, a sum of the light intensities within a single color subpixel on the straight line is represented by:

$$I(x) = \int_{-\infty}^{\infty} f(-t \tan\theta + x, t)\,dt$$

the light intensity of the entire three-dimensional pixel in the horizontal display direction ϕ is provided by:

$$I_s(x)=\sum_i I(x+ip_y\tan\theta) \qquad (I)$$

$$\phi=\tan^{-1}(x/f)$$

wherein f is a focal distance of the cylindrical lens,

and each parameter is set so that the formula (I) becomes approximately a constant value independent of x.

9. A three-dimensional display comprising:

a two-dimensional display, which comprises a plurality of color subpixels arranged in rows extending in a horizontal direction and in columns extending in a vertical direction which is substantially perpendicular to the horizontal direction, the color subpixels of red, green and blue being arranged periodically in the columns; and

a lenticular sheet provided on the two-dimensional display and having a plurality of cylindrical lenses through which the color subpixels are viewed and which are arranged in parallel with one another, the central axis of each cylindrical lens being inclined at an angle of θ to the column of the two-dimensional display,

wherein, when a pitch of the color subpixels in the horizontal direction is p_x, a pitch of the color subpixels in the vertical direction is p_y, and a color subpixel group constituting one three-dimensional pixel includes 3M $\times$ N number of color subpixels where 3M is the number of color subpixels in each row corresponding to one of the cylindrical lenses and N is the number of color subpixels in each column corresponding to one of the cylindrical lenses, a relationship, $\theta = \tan^{-1}[(1-3/N)p_x/p_y]$, is satisfied, where p_x is a pitch of the color subpixels in the horizontal direction and p_y is a pitch of the color subpixels in the vertical direction.

10. The three-dimensional display according to Claim 9, wherein the two-dimensional display that has color subpixels is selected from the group consisting of a liquid crystal display, an organic EL display, and a plasma display.

11. The three-dimensional display according to Claim 9 or 10, wherein the N is the multiples of 3.

12. The three-dimensional display according to any one of Claims 9 to 11, wherein, in a construction of the three-dimensional pixel, $Np_y \leq 3Mp_x$ is satisfied.

13. The three-dimensional display according to any one of Claims 9 to 12, wherein when a horizontal width and a vertical width of the color subpixels are w and h respectively, $w = 3p_x/N$ is satisfied.

14. The three-dimensional display according to any one of Claims 9 to 13, wherein a value of the w is within a range of:

$$\{1-(1/2)(N/3-1)(h/p_y)\}(3p_x/N) \leq w \leq \{1+(N/3-1)(h/p_y)\}(3p_x/N).$$

15. The three-dimensional display according to any one of Claims 9 to 14, wherein a value of the h is $3p_y/(N-3)$.

16. The three-dimensional display according to any one of Claims 9 to 12, wherein, when a distribution of a maximum intensity distribution of rays emitted from one color subpixel is represented by a function f(s, t), and a straight line, which is in parallel with the central axis of each cylindrical lens and in which a

horizontal distance between the straight line and the central axis is x, is represented by $s = -t \tan\theta + x$, a sum of the light intensities within a single subpixel on the straight line is represented by:

$$I(x) = \int_{-\infty}^{\infty} f(-t \tan\theta + x, t)\, dt$$

the light intensity of the entire three-dimensional pixel in the horizontal display direction ϕ is provided by:

$$I_s(x) = \sum_i I(x + i(p_x - p_y \tan\theta)) \qquad (\mathrm{II})$$

$$\phi = \tan^{-1}(x/f)$$

wherein f is a focal distance of the cylindrical lens,

and each parameter is set so that the formula (II) becomes approximately a constant value independent of x.

17. A three-dimensional display comprising:

a two-dimensional display, which comprises a plurality of color subpixels arranged in rows extending in a horizontal direction and in columns extending in a vertical direction which is substantially perpendicular to the horizontal direction, the color subpixels of red, green and blue being arranged periodically in the rows and the color subpixels of the same color being arranged in the columns;

a lenticular sheet provided on the two-dimensional display and having a plurality of cylindrical lenses through which the color subpixels are viewed and which are arranged in parallel with one another; and

an aperture array which is provided between the two-dimensional display and the lenticular sheet, and which has a plurality of apertures,

the central axis of each cylindrical lens being inclined at an angle of θ to the

column of the two-dimensional display,

wherein when a pitch of the color subpixels in the horizontal direction is p_x, a pitch of the color subpixels in the vertical direction is p_y, a pitch of the apertures in the horizontal direction is p_x', a pitch of the apertures in the vertical direction is p_y', and when a color subpixel group constituting one three-dimensional pixel incudes $3M \times N$ number of color subpixels where 3M is the number of color subpixels in each row corresponding to one of the cylindrical lenses and N is the number of color subpixels in each column corresponding to one of the cylindrical lenses, relationships, $p_x = p_x'$, $p_y = p_y'$, and $\theta = \tan^{-1} (3p_x'/NP_y')$, are satisfied.

18. The three-dimensional display according to Claim 17, wherein the two-dimensional display that has color subpixels is selected from the group consisting of a liquid crystal display, an organic EL display, and a plasma display.

19. The three-dimensional display according to Claim 17 or 18, wherein the N is the multiples of 3.

20. The three-dimensional display according to any one of Claims 17 to 19, wherein, in a construction of the three-dimensional pixel, $Np_y' \leq 3Mp_x'$ is satisfied.

21. The three-dimensional display according to any one of Claims 17 to 20, wherein when a horizontal width and a vertical width of the apertures are w' and h' respectively, $w' = 3p_x'/N$ is satisfied.

22. The three-dimensional display according to any one of Claims 17 to

21, wherein a value of the w' is within a range of from $[1-(1/2)(h'/p_y')](3p_x'/N)$ to $[1+(h'/p_y')](3p_x'/N)$.

23. The three-dimensional display according to any one of Claims 17 to 22, wherein a value of the h' is the same as or approximate to a value of the p_y'.

24. The three-dimensional display according to any one of Claims 17 to 20, wherein, when a distribution of a maximum intensity distribution of rays emitted from one aperture is represented by a function f(s, t), and a straight line, which is in parallel with the central axis of each cylindrical lens and in which a horizontal distance between the straight line and the central axis is x, is represented by $s = -t \tan\theta + x$, a sum of the light intensities within a single color subpixel on the straight line is represented by:

$$I(x)=\int_{-\infty}^{\infty} f(-t\tan\theta+x,\ t)\,dt$$

the light intensity of the entire three-dimensional pixel in the horizontal display direction ϕ is provided by:

$$I_s(x)=\sum_i I(x+ip'_y\tan\theta) \qquad (\mathrm{III})$$

$$\phi=\tan^{-1}(x/f)$$

wherein f is a focal distance of the cylindrical lens,

and each parameter is set so that the formula (III) becomes approximately a constant value independent of x.

25. The three-dimensional display according to any one of Claims 17 to 24, wherein each of the color subpixels has a multidomain structure which is

divided into top, bottom, right, and left sections.

26. The three-dimensional display according to any one of Claims 17 to 25, further comprising a diffuser disposed between the two-dimensional display and the aperture array.

27. A three-dimensional display comprising:

a two-dimensional display, which comprises a plurality of color subpixels arranged in rows extending in a horizontal direction and in columns extending in a vertical direction which is substantially perpendicular to the horizontal direction, the color subpixels of red, green and blue being arranged periodically in the columns;

a lenticular sheet provided on the two-dimensional display and having a plurality of cylindrical lenses through which the color subpixels are viewed and which are arranged in parallel with one another; and

an aperture array which is provided between the two-dimensional display and the lenticular sheet and has a plurality of apertures,

the central axis of each cylindrical lens being inclined at an angle of θ to the column of the two-dimensional display,

wherein when a pitch of the color subpixels in the horizontal direction is p_x, a pitch of the color subpixels in the vertical direction is p_y, a pitch of the apertures in the horizontal direction is p_x', a pitch of the apertures in the vertical direction is p_y', and when a color subpixel group constituting one three-dimensional pixel includes $3M \times N$ number of color subpixels where 3M is the number of color subpixels in each row corresponding to one of the cylindrical lenses and N is the number of color subpixels in each column corresponding to one of the cylindrical lenses, relationships, $p_x = p_x'$, $p_y = p_y'$, and $\theta = \tan^{-1} [(1-3/N)p_x'/p_y']$, are satisfied.

28. The three-dimensional display according to Claim 27, wherein the two-dimensional display that has color subpixels is selected from the group consisting of a liquid crystal display, an organic EL display, and a plasma display.

29. The three-dimensional display according to Claim 27 or 28, wherein the N is the multiples of 3.

30. The three-dimensional display according to any one of Claims 27 to 29, wherein, in a construction of the three-dimensional pixel, $Np_y' \leq 3Mp_x'$ is satisfied.

31. The three-dimensional display according to any one of Claims 27 to 30, wherein when a horizontal width and a vertical width of the apertures are w' and h' respectively, $w' = 3p_x'/N$ is satisfied.

32. The three-dimensional display according to any one of Claims 27 to 31, wherein a value of the w' is within a range of:

$$\{1-(1/2)(N/3-1)(h/p'_y)\}(3p'_x/N) \leq w \leq \{1+(N/3-1)(h/p'_y)\}(3p'_x/N).$$

33. The three-dimensional display according to any one of Claims 27 to 32, wherein a value of the h' is $3p_y'/(N-3)$.

34. The three-dimensional display according to any one of Claims 27 to 30, wherein when a distribution of a maximum intensity distribution of rays emitted from one aperture is represented by a function f(s, t), and a straight line, which is in

parallel with the central axis of each cylindrical lens and in which a horizontal distance between the straight line and the central axis is x, is represented by $s = -t \tan\theta + x$, a sum of the light intensities within a single subpixel on the straight line is represented by:

$$I(x) = \int_{-\infty}^{\infty} f(-t \tan\theta + x, t)\, dt$$

the light intensity of the entire three-dimensional pixel in the horizontal display direction ϕ is provided by:

$$I_s(x) = \sum_i I(x + i(p'_x - p'_y \tan\theta)) \qquad \text{(IV)}$$

$$\phi = \tan^{-1}(x/f)$$

wherein f is a focal distance of the cylindrical lens,

and each parameter is set so that the formula (IV) becomes approximately a constant value independent of x.

35. The three-dimensional display according to any one of Claims 27 to 34, wherein each of the color subpixels has a multidomain structure which is divided into top, bottom, right, and left sections.

36. The three-dimensional display according to any one of Claims 27 to 35, further comprising a diffuser disposed between the two-dimensional display and the aperture array.